Ecosystem services and water security

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Chapter 40: Ecosystem services and water security

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[a]Introduction

Water is a cross-cutting issue that is interconnected with many different ecosystems services. For example, within the Millennium Development Goals (MDGs, UN General Assembly, 2000), those goals related to water, such as improving access to drinking water and sanitation, are the only ones that affect the achievement of every other MDG. The interconnectivity of the 'water / food / energy nexus' (see, for example, Bonn Nexus, 2011) reminds us of the threat of the 'perfect storm' (Beddington, 2009); water is required to support the supply of food and energy whilst remaining indispensable to human and other life in itself, and the demand for all three is rising inexorably. Although the volume of water on earth remains constant, and is theoretically self-renewing and self-cleansing through the hydrological cycle at a global level, the proportion of freshwater is only 2.5% of the total water available (UNEP, 2008). Within that percentage, the tiny fraction of freshwater available for human use is threatened locally by pollution and over-abstraction, and by climate change, urbanisation and

population growth. Water provides ecosystem services in all categories. Using the CICES system (Haines-Young and Potschin, 2013) it is a provisioning service in its own right, and also essential to provision of food, some fuels and fibre. Regulating services include flood regulation and water purification, and again water plays a role in regulation of disease and of climate. And in cultural services, water provides aesthetic, spiritual, educational and recreational benefits. It is also part of the mechanism for the underpinning 'supporting' services in classifications that use these (MA, 2005). All life as we understand it depends on water.

[a]Water security

The water security debate is an emerging paradigm, sharpened by the various demands and policy contexts noted above, and especially by the multiple and growing pressures on the resource. Water security can be defined in many ways, reflecting different political perspectives and academic disciplines (Magsig, 2013). Often it is seen as part of a 'national security' concept, with possible military implications linked to fears of water wars. There is also an emerging discourse around environmental or ecological security, perhaps most relevant to this book, but also, there is the concept of human security and the provision of water services of different types, for health, well-being and food production. The 'water wars' issue is a good example of lazy conceptualisation and theoretical trends. There is far more evidence of cooperation over water, and there has only ever been one water 'war' as such. In the 1980s, Boutros Boutros-Ghali, then Secretary-general of the UN, suggested that the next wars in the Middle East would be over water, not politics or oil; and that has not yet (thankfully) been the case. But there are many examples of smaller-scale conflicts over water, locally, and in

many regions, and water services of many different types are targets in those conflicts. The ecological implications of human impacts on the water resource, direct and indirect, have been extensively noted in other parts of this book, and will be returned to further below. The human security dimension is though perhaps the most interesting if seen from the perspective of water services of different types. Linked to equally difficult questions around development, sustainable or otherwise, the concept of water services recognises that water is essential to life, and the provision of basic needs, but also that water services are vital for economic development. It is therefore necessary to acknowledge the tensions between economic development and the protection of the resource base on which development itself also depends.

Specific to water, a number of definitions have emerged from the domain of public policy. Some years ago, the Global Water Partnership stated that "[w]ater security, at any level from the household to the global, means that every person has access to enough safe water at affordable cost to lead a clean, healthy and productive life, while ensuring that the natural environment is protected and enhanced" (Rogers and Hall 2000, p.12). The United Nations Development Programme considers that "water security is about ensuring that every person has reliable access to enough safe water at an affordable price to lead a healthy, dignified and productive life, while maintaining the ecological systems that provide water and also depend on water" (UNDP, 2006, p.3). Most recently, UN-Water defined water security as "[t]he capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and

for preserving ecosystems in a climate of peace and political stability" (UN-Water, 2013, p.1). Thus human needs are included, as are developmental needs, together with the protection of the environment and ecosystem services. The next two sections of this chapter will consider firstly, the meanings and relevance of water services, and secondly, the meanings and role of regulation in managing water supply; the concluding section will consider how the concept of ecosystem services is both framing and reconceptualising the water policy agenda.

[a] Water supply and water services

In the context of this book, water services might be understood as water-related ecosystem services, and that is certainly one way that the phrase can be interpreted. However, more generally, the term 'water services' is often used to designate the provision of (urban) water services, that is, the supply of drinking water, water for commercial use and wastewater services. It can also be understood as the provision of basic sanitation, likely not to be waterborne but still with consequences for the water environment. These services may be provided by public or private providers, or through self-supply at individual or community levels. They are relevant to basic human needs (drinking, cooking, and basic hygiene) and linked to the debate around the human right to water, which is also helping to frame and re-conceptualise debates over water services.

In a seminal article, Gleick argued that 50 litres / person / day (LPD) was sufficient to provide for health and hygiene (Gleick, 1996), but not for waterborne sanitation. A range of 20-40 LPD is also often cited; for example, South Africa provides a Basic Water supply of 25 LPD (DWAF, 2003) which should be provided free by municipalities to indigent households and supplied to all at a lifeline rate.

This is also incorporated into the South African concept of 'the Reserve', an innovative mechanism for prioritising and recognising both basic human needs and ecological requirements in terms of environmental flow. In terms of the core ecosystem service of providing drinking water, globally this has been estimated at somewhere around 10% of global withdrawals (UN-Water, 2009).

Water services may however be defined more broadly than this. The European Water Framework Directive[1] (2000/60/EC, WFD) defines water services as

"all services which provide, for households, public institutions or any economic activity:

(a) abstraction, impoundment, storage, treatment and distribution of surface water or groundwater,

(b) waste-water collection and treatment facilities which subsequently discharge into surface water." (WFD Art.2.)

This understanding of water services goes beyond the provision of domestic water and indeed beyond the provision of piped urban water supply to industry or commercial users. As it specifies 'any economic activity', it is at least arguable that it includes water for agriculture; and the extent of the definition has been referred to the European Court of Justice (European Commission v Germany C-525/12). Under the WFD, states must have pricing policies to incentivise sustainable water use, and "take account of the costs of water services, including environmental and resource costs" (WFD Art.9). When EU Member States submitted their River Basin Management Plans, within which all these

[1] http://ec.europa.eu/environment/water/water-framework/index_en.html

requirements should be reported, the analysis conducted by the European Commission suggested that most states had addressed cost recovery and pricing policy in terms of urban supply but had not applied it to agricultural water. Globally, agricultural use amounts to some 70% of all water withdrawals, and in many countries farmers are the group who are least likely to be paying the full cost of the water they use. This then affects the supply of other provisioning services depending on water, especially food and fibre.

Agriculture is of course not a homogenous sector; it ranges from vast grain monocultures, pastoral ranges, hothouse horticulture, to the subsistence farmers eking a living in many parts of the world. It is difficult to obtain good data on sectoral use, and certainly not within sectors; it is likely that subsistence farmers are less efficient and have less advanced irrigation technology, though this may also mean that substantial return flows are returned to the basin. A relevant question is whether this use – subsistence farming – should come within the concept of basic human needs, found for example in the UN Watercourses Convention (where 'special regard' should be given to 'vital human needs', UN 1997 Art.10) but also in the human rights discourse. The UN Economic and Social Council, in its General Comment 15, has suggested that small-scale agricultural use of water should be included in the human right to water (UN, 2002, para.7) as part of the right to food. But acceptance of this inclusion would significantly expand the overall requirement for water for basic human needs, and may also cause some tensions with another water paradigm, Integrated Water Resources Management (IWRM). IWRM has been much discussed in policy and academic literature, and this is not a place to revisit that debate at any length. It is, however, generally taken to include an integrated approach to the resource (especially, managing surface

water and groundwater together); an integrated approach to catchments (recognising catchment boundaries, and recognising the interrelationship between land and water); and a participative approach, engaging stakeholders in the management process. Notably, one of the few texts dealing specifically with law and ecosystem services (Ruhl et al., 2007) recommends a multi-layered planning system that is highly compatible with many versions of IWRM. Often, the introduction of IWRM will involve some form of legislative reform in order to introduce the specified processes and mechanisms, and perhaps also to provide for the reallocation of water. Water allocation may be carried out within a prioritisation of uses within a state (or a basin), in which case basic human needs, or water for food production or industry, may be a priority. If a state explicitly recognises a constitutional or human right to water, then that will inevitably be prioritised, but it may not be the only priority. If there is a human right to water, then in the human rights discourse will 'trump' any other right, at which point the extent of that right in volumetric terms, and specifically whether it includes subsistence farming, may make a significant difference to the volumes of water left for other purposes. Nonetheless, both IWRM and the human right to water theoretically remain high on global, regional and national policy agendas. Whether or not these policy aims are implemented is another matter. As well as potential tensions between the different uses of water, there may be tensions with other ecosystem services provided by water.

[b] Water services beyond basic human needs

A broader analysis of the ecosystem services provided by water takes us beyond water supply for basic human needs. Some water is used for industrial purposes,

perhaps 20% of withdrawals, but again sectoral figures are variable and may be calculated in different ways. Water may be used as an ingredient, as part of a cooling process, or as a means of exiting industrial waste. Significant amounts of water are needed for the production of soft and alcoholic drinks, much of which is now pumped from aquifers in what is a form of water mining. Water is also used in many production techniques, and may in this way conflict with other uses such as agriculture, human consumption and spiritual values. The leather industry on the banks of the Ganges is a major polluter and competes in this way with other uses of water.

Some domestic supply in developed countries is well in excess of the basic requirements suggested by Gleick or the WHO, and if there is a wastewater system this will at least double the minimum supply required. Where human wastes are disposed of via waterborne systems, this could be seen as a regulating, purification service, mediating wastes through water flows, but given the scale and density of human habitation, this will not function without some type of further treatment. In the near future, there is likely to be much more emphasis on treating wastewater to make it fit for reuse, and for different treatment options for different forms of reuse.

Both the provision of a networked supply and almost all treatment options for wastewater (domestic and industrial) will require energy, which in turn may use more water, reminding us again of the water-food-energy nexus. Similarly, most non-subsistence agricultural operations will require energy in different forms, whether for machinery, or transport, or the production of fertiliser and pesticides. Whilst provision of basic human needs is a clear imperative in terms of domestic

water security, so too is food, and water for food production. Again, this is not the place to explore in detail the widely-debated concept of virtual water (Allan, 2011), or water 'footprints' (Hoekstra and Chapagain, 2008) but these concepts can be helpful in understanding the flows and exchanges of benefits based on water that take place through international trade. Ironically, water-rich, developed countries often import large amounts of irrigated foodstuffs from countries with much less water resources. This is also true for timber, another vital provisioning service. Forest management is linked closely to water management, in terms of competition for water, and in terms of sustainable management of indigenous forestry for climate regulation. It is unsurprising that in the developing world, much of the ecosystem services debate is focused around forest protection (Bennett and Carroll, 2014), partly as a result of the funding mechanisms in the UN Convention on Climate Change.[2]

As noted above, agricultural production is the major consumer of fresh water. Countries may choose to restrict (by regulation or incentive or both) the crops grown by farmers, or the total extent of agricultural activity, and import water-intensive foodstuffs from elsewhere, to increase the water available for other purposes. They may choose to encourage large-scale cash crop agriculture at the expense of small subsistence farmers, or to maximise the latter. All of these policy choices may be influenced or determined at national level by perceptions of food security, water security, or broader notions of security in its military or civilian senses. Fisheries are also a vital provisioning service and a major source of protein in developing countries. Other uses of the water environment may impact

[2] http://unfccc.int/2860.php

negatively on natural fisheries, whilst aquaculture brings its own environmental impacts locally.

Hydropower is also a major user of water and contributes to human security in different ways. Although non-consumptive, it affects flow regulation and hence, availability for other sectors. Hydroelectric power is one of the most important energy sources today, especially for developing countries. The industrialised countries have developed almost all of their hydropower potential, but in other parts of the world there is still a large potential for development. As rivers are often trans-boundary there may be conflicting interests involved. For example, in the Mekong, while Laos is in the process of building dams on the main Mekong River, Cambodia and Vietnam have objections to this as it will impact on agricultural production, especially in the Mekong Delta which is the major rice producing area of Vietnam, and one of the most important in the world. Meantime hydro also has significant, usually negative effects on ecosystems.

Finally, in terms of direct use by humans, the cultural (spiritual, recreational) services provided by water are usually related to water *in situ*, in its 'natural' state at any given time. In many parts of the world water is seen as inherently spiritual and an important cultural signifier. For example, the Ganges River in India is associated with the cycle of life and death and in parts of Africa water bodies such as lakes and waterfalls are seen as the habitat of spirits. In developed countries, the value of water is still seen as an important contributor to quality of life in a social as well as economic sense. To access these services, therefore, it is necessary to maintain or protect some waterbodies and their surrounding environments.

[b] Water for the environment

Many ecosystem services involving water are not directly 'water services' in anthropocentric terms, but rather services provided to the environment, on which human and other life depends. Protection or preservation of ecosystems, as might be required under the UN Watercourses Convention[3] (UN 1997 Art.20), the Convention on Biological Diversity[4] (CBD) or the Ramsar Convention[5] on the protection of wetlands for migratory birds will assist in this aims, as will many regional, national and local legal instruments, whether in pursuit of these treaties, or independent of them.

The need for environmental flows can be built into the regulatory and management systems for water in a variety of ways. Water can be retained from other uses for the environment, with specific temporal and volume levels of water flows mandated before any abstractions can be made for other purposes (with the likely exception of basic human needs). Specific environmental allocations of water can be made to provide for ecosystem needs. Both of these techniques can operate in a planned system such as one based on IWRM, and many countries are aiming at adopting these approaches. Thus under the WFD, environmental flows should be maintained or increased to achieve 'good ecological status'. In South Africa, the Reserve includes an environmental reserve, which has proved harder to calculate than the 25 LPD mandated for human use. In the Murray-Darling in Australia, there is an environmental watering plan, which includes buy-backs of water for the environment (Government of Australia Water Act, 2007). Where

[3] http://www.unwatercoursesconvention.org/
[4] http://www.cbd.int/
[5] http://www.ramsar.org/

there is a water market in place, it may also be possible for private interests such as fisheries trusts to purchase water for the environment. In all of these systems, trade-offs between the environment and human uses for development operate in different ways, but all give some recognition of ecological needs. In the EU, the objective of the WFD is good ecological status, but with grounds for exemptions and extensions. In South Africa and some Australian states, there is an ecological classification system for waterbodies that does not have an overall goal of a specific class, but recognises that human needs and development activities will mean that some waters will achieve a lower class. Under Federal Australian law, perhaps reflecting its more recent adoption, protection of ecosystem services and functions are an explicit driver. Maintaining environmental flows will increase the availability of many provisioning and regulating services, both those used directly by humans and those that indirectly support the resource base. Only by protecting all those services will there be water security in the fullest sense.

[a]Water services, water security and water regulation

Just as the concept of water services can hold several different meanings so too can the concept of water regulation. Again it is possible that the ecosystems debate can bring fresh conceptualisation and integration of different perspectives to bare on regulation, and a more human-centred approach is likely to lead to a narrower understanding of the term. Regulation in a non-legal sense is used in relation to the water environment in several different ways, in the form of flow regulation for irrigation, and protection of instream and riparian zone ecosystems; or regulating services in the ecosystem paradigm. Perhaps amongst these different

understandings, the lawyers have the narrowest understanding of all, but nonetheless law relates to all aspects of water management.

Water law applies both to the water resource and to water services. In terms of managing the resource base, legal frameworks can and should establish the systems and processes for water management, including stakeholder engagement and IWRM. Law will also be used to allocate water, and where changes are being made to water rights' regimes these changes may be contentious. They are likely to require a high-level Act or Code, which in turn should provide opportunity for wider debate, including the engagement of stakeholders over a period of time (see, for example Hodgson, 2006). If, for example, there is to be provision for environmental flow, this may be addressed in these rules. Finally, water resources law will also regulate water quality, controlling inputs into the system from human sources and linked to broader environmental law frameworks at different levels of government. Controls over water quality and quantity are linked and this can be seen clearly in the ecosystem services approach; there must be enough water in the system, and of sufficient quality, to continue to maintain the desired services.

In terms of the (legal) regulation of water services, this is firstly concerned with drinking water quality and other service standards for water supply. The latter include pressure, and access / availability, for example, as well as: distance to the source for rural areas and collection time in urban areas; number of households served by a standpipe; hours / day for which piped supply is available. Drinking water quality as such is likely to be subject to standards based on the WHO guidelines or a subset of these (WHO, 2004). All of these might be applied and enforced by public health departments. Secondly, for sanitation and wastewater,

there may be standards detailing the type of facilities provided and access to these, any maintenance obligations and perhaps customer standards for sewer flooding. Increasingly, regulatory and policy attention is turning to the correct treatment and effective reuse of wastewater (WHO 2006; European Commission 'Water Blueprint' 2012; and UN-Water, 2014).

There are also links between water services and water resources law. Service providers at some level will be abstractors of raw water and also will be responsible for discharges from wastewater systems. Further, upstream catchment protection and water safety planning (which is suggested to be mandatory under the current WHO guidelines) bring water supply issues firmly into the ambit of land use and catchment management. The more upstream protection, the less downstream treatment will be required. The regulation of both water services delivery and the raw water resource are critical to the maintenance of water security at a domestic level; if the water supplied is unsafe, and / or wastewater is allowed to contaminate surface or groundwater, then the starting point of all the definitions of water security noted above, the life and health of the individual, will be failed. If the sources are protected and the wastewater managed for reuse then the wider set of ecosystem services is better protected.

One further aspect of legal regulation may be of interest in the ESS debate. In a trans-boundary context, the principal international legal instrument, the UN Watercourses Convention, enables the concept of benefit-sharing, within the core principle of equitable and reasonable utilisation, as an alternative (or more likely in addition) to allocating water. (See, for example, in the context of ecosystem services, Rieu-Clarke and Spray, 2013). In theory at least, if all the states in a

trans-boundary basin are cooperating, benefit-sharing is a preferable way to maximise the returns on every cubic metre of water available. Alternatively, if cooperation is not forthcoming, as is currently evident in a number of trans-boundary basins worldwide, benefit-sharing will be seen as a threat that detracts from security of different types, including water security. The debate outlined above over food (-and-water) security and the policy choices available also plays out internationally; but only a cooperative approach will maximise the protection of the resource and the services it provides.

[a] Conclusions

In conclusion, water plays a unique role in the provision of many ecosystem services and it is also vital from a perspective of different forms of security. This chapter has sought to identify the ecosystems services delivered by water and the many different uses to which water is put, in the context of the emerging debate around water security. Whilst the security debate is often framed in narrow terms of state (or individual) interest, there is some recognition internationally and by national policymakers that a broader and more cooperative approach to managing water for all its human uses is essential to cope with current global changes, especially population growth, climate change, urbanization and environmental degradation. Whilst the ecosystem services paradigm is primarily anthropocentric, it nonetheless recognizes the fundamental biophysical imperatives on which all life depends – the deepest and most fundamental form of security. Drawing that paradigm into the water security debate, and exposing different disciplines,

sectors and policymakers to the ecosystem imperative, could help to foster a wider and more cooperative approach.

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